

## VERTEBRAL OSTEOSYNTHESIS EQUIPMENT

This patent application claims the priorities to :

- FR 03 07779, filed on June 27, 2003 ;
- US Provisional application N° 60/490,516, filed on July 29, 2003.

5       The present invention relates to vertebral osteosynthesis equipment.

A vertebral osteosynthesis equipment generally includes bony anchoring members, such as pedicular screws or lamar hooks, one or two linking rods, intended to be connected to these anchoring members and to be attached to the vertebrae by dint thereof, and parts for connecting this(these) linking rod(s)  
10       to these anchoring members. The equipment may also comprise length-adjustable crossbeams, which link transversally two parallel linking rods in order to hold said rods with respect to one another.

In an existing type of equipment, each anchoring member comprises a proximal threaded stud and a base portion intended for bony anchoring  
15       thereof. Each connecting part comprises a rounded section intended for surrounding a linking rod and two parallel drilled wings, these wings being intended for engaging onto said proximal threaded stud and for being clamped, using a nut screwed on the stud, against a bearing surface provided on said base portion. This clamping causes the clamping of said rounded  
20       section around the linking rod and thus ensures longitudinal immobilisation of this rod with respect to the anchoring member. The anchoring members may be of "monoaxial" type, i.e. comprise a proximal threaded stud integral with the base portion, or may be of "polyaxial" type, i.e. comprise a proximal threaded stud articulated with respect to that base portion.

25       When installing the equipment, the anchoring members are placed, then extension pieces are engaged on the proximal studs of these anchoring members. The connecting parts, with the rod(s) engaged in their rounded portions, are then engaged on these extension pieces and run down along the latter until they rest on the proximal zones of the base portions of the  
30       anchoring members. The extension pieces are then withdrawn and the clamping nuts are placed.

To enable adequate correction of the position of the vertebrae, the linking rod(s) must be shaped into one or several planes. Such operation leads to

successive trials and errors until adequate form is obtained. Successive insertions and retractions of the extension pieces and successive running down operations of the assemblies composed of connecting parts - linking rods along the latter, then withdrawing the extension pieces for placing the nuts, are then relatively tedious and time-consuming operations.

Moreover, there is always the risk of nut breaking loose from its installing instrument, and then, the necessity of retrieving this nut before placing it back on said this instrument ; all this process contributes to make the implantation of the equipment longer and more complex.

The purpose of the present invention is to remedy these essential shortcomings, by providing vertebral osteosynthesis equipment which is easier and faster to implant than any extant equipment.

The equipment of the invention comprises, in itself,

- bony anchoring members, such as pedicular screws or lamar hooks, whereof at least one comprises a proximal threaded stud intended for receiving a nut, and a base portion intended for anchoring to a vertebra ;
- one or two linking rods, intended to be connected to these anchoring members and to be attached to the vertebrae by dint thereof,
- parts for connecting this(these) linking rod(s) to these anchoring members, and
- extension pieces intended for engaging on the proximal stud(s) of the anchoring member(s) for running down connecting parts on this or these proximal stud(s) until they rest on the proximal zone(s) of the base portion(s) of the anchoring members.

According to the invention, the proximal stud of at least one anchoring member and the extension piece intended to be used with this anchoring member include positioning means enabling to position the extension piece on the free end of the proximal stud, concentrically thereto, these positioning means being such that the extension piece comprises an end distal portion whereof the external diameter is sized in order to let through the nut thereon.

The extension piece may thus be positioned on the free end of the proximal stud, concentrically thereto, then the nut may be run down towards the implantation site without retracting the extension piece, whereas such

descent does induce any risk of losing this nut. There results therefrom that the equipment is placed more quickly and more reliably.

The nut may in particular be engaged on said proximal stud at the same time as the connecting part.

5 Said positioning means comprise advantageously a rod integral with the proximal stud or of the extension piece and a bore provided, respectively, in the extension piece or the proximal stud, whereas this rod may be engaged in this bore.

10 Said positioning means comprise advantageously means enabling axial connection of the proximal stud with the extension piece.

The extension piece may therefore no get lost.

According to a preferred embodiment of the invention, the proximal stud comprises a threaded proximal rod, and said end distal portion of the extension piece comprises a tapered hole for screwing the extension piece on  
15 this proximal rod.

The extension piece may, outside said end distal portion, be of flexible structure, for easy positioning thereof on the free end of the proximal stud, notably screwing or unscrewing thereof when the threaded rod of the proximal stud is not parallel to the engaging direction of the extension piece.

20 This flexible structure may notably be in the form of a metal wire wound into a spiral, with preferably contiguous spires. It may also be an elastic wire, a cable or other.

The invention will be better understood, and other characteristics and advantages thereof will appear, with reference to the appended schematic drawing, representing, for non-limiting exemplification purposes, a preferred  
25 embodiment of parts included in the equipment affected.

Figure 1 is a partial view of a polyaxial pedicular screw, of a linking rod seen from its end, of a connecting part and of a nut, in cross-section, and of an extension piece partially in cross-section, included in such equipment ;

30 Figure 2 is a view of these parts similar to Figure 1, during assembly, and

Figure 3 is a view of these parts similar to Figure 2, once the assembly completed.

Figure 1 represents a polyaxial pedicular screw 1, a rod 2 connecting several of these screws 1, a part 3 connecting this rod 2 to one of these screws 1, a nut 4 enabling assembly of the linking rod 2 to this screw 1 and an extension piece 5 for running down the connecting part 3 and of the nut 4 on the proximal zone of the screw 1.

The screw 1 comprises a proximal threaded stud 6 and a base portion 7. The stud 6 is intended for receiving the part 3 engaged thereon and the nut 4 screwed thereon while the base portion 7 is intended for insertion into the pedicula of a vertebra.

The stud 6 exhibits a threaded cylindrical portion 10, a spherical distal head 11 and a threaded proximal rod 12.

The portion 10 exhibits a zone 15 of reduced diameter, enabling to break its proximal portion after placing and clamping the nut 4, as appears by comparison of Figures 2 and 3.

The head 11 exhibits a diameter double that of the portion 10 and looks like a spherical cap. This head 11 is intended for engaging in a proximal cavity 16 delineated by the proximal zone of the base portion 7 and for retention in this cavity 16 by crimping a proximal wall 17 exhibited by this portion 7. After crimping, the wall 17 is shaped in order to have hemispherical proximal form. As shown on Figure 1, the dimensions of the cavity 16 and of the aperture delineated by the wall 17 after crimping to let through the stud 6 are such that a multidirectional backlash of this stud 6 with respect to the base portion 7 is possible.

The threaded rod 12 has a diameter smaller than that of the stud 6 and enables the assembly of the extension piece 5 on this stud 6 by screwing.

The base portion 7 comprises a proximal collar 18, intended for abutting against the pedicula of the vertebra. This collar 18 exhibits several radial notches 19, notably four notches at 90° to one another, for holding the base portion 7 in rotation when clamping the nut 4.

The linking rod 2 is cylindrical and exhibits such rigidity as to hold several vertebrae with respect to one another. This rod 2 is however deformable in order to be shaped relative to the correction of the rachis to be performed.

The connecting part 3 comprises a rounded section 20 intended for hugging the linking rod 2 and two parallel lateral wings 21.

The distal wing 21 is drilled with a hole for engaging the part 3 on the stud 6 and exhibits a boss 24 delineating a distal cavity 25 substantially  
5 hemispherical in shape, coaxial to said hole and of diameter greater than that of the wall 17. There exists therefore a clearance between this wall 17 and the wall of the part 3 delineating the cavity 25, this clearance enabling the angular orientation of the stud 6 with respect to the base portion 7.

The proximal wing 21 comprises a cavity 27 wherein a corresponding  
10 conical zone, exhibited by the nut 4, is intended for engaging.

The extension piece 5 comprises an end distal portion 30 and a body 31.

The portion 30 exhibits a tapered bore 32 shaped for screwing the extension piece 5 on the threaded rod 12 and a smooth external wall. The diameter of this portion 30 is smaller than the internal diameter of the thread of  
15 the nut 4 so that the nut 4 may run along this portion 30 when engage for sliding on the extension piece 5.

The body 31 is in the form of a metal wire wound into a spiral, with preferably contiguous spires, conferring flexible thereto. This flexible structure facilitates the screwing or the unscrewing of the extension piece 5 when the  
20 threaded rod 12 is not parallel to the engaging direction of this extension piece 5.

In practice, the number of screws 1 necessary to the treatment to be performed is placed in the pediculae of the vertebrae affected, then the extension pieces 5 are screwed on the rods 12. The connecting parts 3, with  
25 or without the rod(s) 2 engaged in their rounded portions 20, and the nuts 4 are then engaged on these extension pieces 5 and run down along the latter until the parts 3 rest on the walls 17.

After adequate conformation of the rods 2, the nuts 4 are clamped for clamping the connecting parts 3 against the walls 17 and therefore immobilise  
30 these parts 3 and the studs 6 with respect to the base portions 7.

After retraction of the extension pieces 5, the studs 6 are cut off at tapered zones 15.

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As shown by the foregoing, the invention provides a vertebral osteosynthesis equipment enabling to run the nuts 4 down towards the implantation site without retracting the extension pieces 5, this descent showing no risks of losing these nuts 4.

5        There results that the equipment may be installed more quickly and more reliably.

10        Obviously, the invention is not limited to the embodiment described above for exemplification purposes but extends to all the embodiments covered by the claims appended therein. Notably, one would not depart from the framework of the invention by arranging said threaded distal portion 30, so that it enables to screw the nut 4 thereon. This screwing would enable, if necessary, to use the extension piece 5 to bring the part 3 against the base portion 7.